

Laser Studies of the Photodissociation Dynamics of Cometary Radicals

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In the past year we have shown that in the 193 nm photolysis of C_2H , the C_2 radical is produced in a variety of electronic, vibrational, and rotational states. The relative population of the vibrational and rotational states of $C_2(A^1\Pi_u)$, $C_2(B^1\Sigma_g^+)$, and $C_2(a^3\Pi_u)$ have been determined in a static gas cell and in a pulsed molecular beam. It seems as though the original angular momentum of the C_2H molecule appears as part of the angular momentum of the C_2 radical. We are now trying to discover the mathematical relationship that governs this mapping. This work has supplied new information about the bond dissociation energy of the C_2 radical. We have also detected $C_2(b^3\Sigma_g^-)$ and $C_2(^1\Delta_g)$ in the photolysis of C_2H via time resolved infrared emission spectroscopy. In the former case vibrational excitation up to $v''=4$ is observed. All of our results suggest that the C_2 models in comets need to consider the presence of vibrationally excited C_2 radicals in comets.

The laser induced fluorescence spectra of the C_3 has been observed as a product of the 193 nm photolysis of allene and propyne. The populations of the rotational levels are identical in both cases. This result has led us to conclude that an isomerization reaction occurs in the photolysis of propyne which leads to the same C_3H_2 intermediate that is formed in the photolysis of C_3H_4 . Since the former molecule is one of the most abundant in the interstellar medium it is also likely that its precursor is also present in comets. This would explain why C_3 is observed in comets.

Publications

1. 1989 W.M. Jackson. Recent Laboratory Photochemical Studies and Their Relationship to the Photochemical Formation of Cometary Radicals. Accepted for publication by Kluwer Academic Publishers.
2. 1990 Yihan Bao, R.S. Urdahl, and William M. Jackson. Detection of $C_2(B^1\Sigma_g^+)$ in the Multiphoton Dissociation of Acetylene at 193 nm. *J.Chem.Phys.* **94**, 808.
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4. 1991 W.M. Jackson, Yihan Bao, and R.S. Urdahl. Implications of C_2H Photochemistry on the Modeling of C_2 Distributions in Comets. Submitted for publication by J. Geophys. Research.